Zoological Society of London for February of the present year, and is entitled "A Synopsis of the Genera of the Family *Soricidæ*." Probably the most extensive collection of these interesting little mammals ever examined by a single investigator, came under the hand of the writer of the works just quoted, wherefrom to make his deductions. His classification is most complete and acceptable, and goes to show that the Shrews are first to be divided into two sub-families, viz. the *Soricidæ*, and the *Crocidurinæ*, the first being characterized by having their teeth red-tipped, while in the latter the teeth are white. Five genera make up the first sub-family—which stand, *Sorex*, *Soriculus*, *Blarina*, *Notiosorex*, and *Crossopus*. In the *Crocidurinæ* we find six genera—namely, *Myosorex*, *Crocidura*, *Diplomesodon*, *Anurosorex*, *Chimarrogale*, and *Nectogale*. This adds four genera to M. Milne-Edwards's list, and from the same omits the genus *Neosorex*. Dr. Dobson believes that "the red-toothed Shrews diverged from the white-toothed, development having proceeded on somewhat similar lines in the descendants of both according to similarity of environment and modes of life." Of Dr. Merriam's genus and type, *Atophyrax bendirii*, he says that "there are no leading characters which would enable one to define the genus, were I inclined to admit it in my synopsis."

It is refreshing in these days to meet with such classification, and such an able classifier—one who, as Dr. Dobson most emphatically does, draws good strong lines in taxonomy, and discourages the hair-splitting methods adopted by some mammalogists in these days. R. W. SHUFELDT.

Takoma Park, D.C., September 13.

Musical Sands.

IN reference to the note respecting Mr. Hyndman's query *re* sonorous sand (NATURE, October 2, p. 554) it may be interesting to him, and others, to know that in our own islands musical sand is by no means rare. In the second edition of my "Musical Sand," shortly to be issued, I shall give a list of the places at which it occurs in England, Scotland, Ireland, and Wales, showing that only *observers* are rare—not the sands.

My investigations since my paper was first published nearly two years ago have brought many new and interesting facts under my notice, not the least being that the musical sands at Studland Bay are always mute during an easterly wind. This I have been able to account for.

About three years ago I propounded a theory to account for the emission of these musical sounds from sands; briefly it is that they are the result of the rubbing together of millions of clean sand-grains very uniform in size: two such grains rubbing together would not produce vibrations audible to us, but the *accumulation* of such vibrations issuing from millions of surfaces, and, approximately, of equal length, would produce a note sufficiently powerful to be sensible to us.

This theory has long been published, and though it has been examined by some of our most eminent physicists, and tested in a variety of ways since, nothing has been suggested which has caused me to abandon it. I shall be pleased to send Mr. Hyndman a copy of my first paper on the subject.

Bournemouth, October 6. CECIL CARUS-WILSON.

With what Four Weights (and a Pair of Scales) can be Weighed any Number of Pounds from 1 to 40 inclusive?

WITH two weights four amounts can be weighed, viz. each weight and the sum and difference of the two.

With a third, in addition to these four, the sum and difference of each and the third can be weighed. Three weights therefore give 13 amounts. Similarly a fourth weight gives $13 + 2 \times 13 + 1$, or 40 amounts, exactly.

It is therefore evident that each amount must be arrived at by only one combination, and that the sum of the weights must be 40 pounds. To weigh 39 pounds, then, we shall clearly want a 1 pound weight. With 1 and 39 we can weigh 1, 38, 39, 40. For the next weight 2 clearly will not do, as 1 could be arrived at in two ways. Taking 3, we find that 1, 3, and 36 give us 1, 2, 3, 4, 32, 33, 34, 35, 36, 37, 38, 39, 40. Now to get 5 without getting any amount by more than one combination we clearly want 9, and this will be found to solve the question, the weights being 1, 3, 3^2, 3^3. A fifth weight of 3^4 will enable us to weigh any number of pounds up to 121, and so on.

E. R. F.

Protective Coloration of Eggs.

IN view of Mr. Grensted's letter to NATURE last year (vol. xli. p. 53), asserting the writer's belief that the egg of the red-backed shrike varies with the tint of the lining material of the nest, and of my own reply to this (same volume, pp. 129-30), I had intended this summer to examine as large a series of nests and eggs as possible, in order to verify or disprove my former observations. I have, however, been unable to devote any time to the matter; and have only obtained two nests—both from the neighbourhood of Evesham. In each of these, I must confess that Mr. Grensted's contention is borne out. The lining of one nest is dull brown in colour; and the eggs (5) are of a mouldy-brown ground-colour, tending towards dull green. The lining of the second is brighter in tone; and contains a small fragment of red flannel. The eggs (5) of this nest show the commoner flesh-coloured ground.

In spite of these two instances, I must hold to my former opinion, that the correlation of ground-colour and environment is very imperfect in the nests and eggs of these birds. Next year I hope to be able to examine a greater number of nests.

E. B. TITCHENER.

Mote House, Mote Road, Maidstone, October 2.

LUNAR PHOTOGRAPHY.

THE idea of employing the process invented by Daguerre and Niépce for the purpose of obtaining photographs of our satellite was first suggested by Arago in a report made to the Paris Academy of Sciences on August 19, 1839. Daguerre acted on the suggestion, but, in spite of a long exposure, he obtained only feeble impressions, in which all details were conspicuously absent (Arago, "Œuvres," vol. vii. p. 458). The first photographic representations of the moon may therefore truly be said to have been made by Dr. J. W. Draper in America by means of a Newtonian reflector of five inches aperture. The specimens were presented to the New York Lyceum of Natural History. The following is an extract from the minutes of that association:

"March 23, 1840. Dr. Draper announced that he had succeeded in getting a representation of the moon's surface by the daguerreotype. . . . The time occupied was 20 minutes, and the size of the figure about 1 inch in diameter."

Dr. Draper also wrote in September of the same year:—

"There is no difficulty in procuring impressions of the moon by the daguerreotype beyond that which arises from her motion. By the aid of a lens and a heliostat, I caused the moon-beams to converge upon a plate, the lens being three inches in diameter. In half an hour a very strong impression was obtained. With another arrangement of lenses I obtained a stain nearly an inch in diameter of the general figure of the moon, in which the places of the dark spots might be indistinctly traced" (*Phil. Mag.*, vol. xvii. p. 222, 1840).

In 1850, W. C. Bond, in conjunction with J. A. Whipple, a photographer of Boston, obtained some really good daguerreotypes of the moon. The instrument used was the equatorial of 15 inches aperture belonging to Harvard College Observatory, and images from two to three inches in diameter were obtained on plates adjusted at its focus. Some of these pictures on glass, and mounted for the stereoscope, were exhibited in London at the Great Exhibition of 1851, and also at Paris ("Annals, Observatory of Harvard College," vol. i. p. clvii.).

Also in 1850, Niépce de St. Victor obtained a strong impression of the full moon in twenty seconds on an albumenized glass plate sensitized with silver chloride. He had only discovered this photographic process a few months previously, and the plate was exposed in order to test the efficiency of the film employed. No attempt was made, however, to follow the moon's motion, so the pictured disk could hardly have exhibited the circular outline of the object it portrayed (*Comptes rendus*, vol. xxx. p. 710, 1850).

After the discovery of the collodion process by Scott Archer in 1851, lunar photography grew apace. Warren De La Rue exhibited some photographs of the moon at the Royal Astronomical Society in 1853. With respect to these pictures he afterwards remarked: "At the latter end of 1852 I made some very successful positive lunar photographs in from two to thirty seconds on a collodion film, by means of an equatorially mounted reflecting telescope of 13 inches aperture, and 10 feet focal length, made in my workshop, the optical portion with my own hands, and I believe I was the first to use the then recently discovered collodion in celestial photography." No automatic driving motion was attached to the telescope, and the moon's motions both in right ascension and declination were followed by adjusting a sliding frame attached to the eyepiece holder, in the diagonal parallel with the moon's apparent path (Brit. Assoc. Rep., Aberdeen, 1859, p. 131).

In July 1853, Prof. J. Phillips obtained photographs of the moon 1¼ inch in diameter on a collodion plate exposed for five minutes in the first focus of a 6½-inch refractor. Some of the pictures were exhibited at the Hull meeting of the British Association in September 1853, on which occasion Prof. Phillips read a paper "On Photographs of the Moon," and pointed out the many advantages to be gained by the development of lunar photography (Brit. Assoc. Rep., Hull, 1853, p. 14). He also dwelt on the desirability of using reflecting telescopes for the purpose because of the fact that in such instruments the chemical and optical foci coincide.

The Rev. J. B. Reade, the discoverer of many important improvements in photographic processes, made several not very successful attempts to obtain daguerreotypes, whilst Bond and Whipple were producing such pictures in America. Later, in 1854, by exposing a collodion plate for thirty-five seconds in the focus of a reflector having an aperture of 24 inches, a negative of the full moon was obtained from which enlargements 9 inches in diameter were made. These results were exhibited at the meeting of the British Association held at Liverpool in 1854 (British Association Report, 1854, p. 10).

Mr. Hartnup, of the Liverpool Observatory, in conjunction with Dr. Edwards and Mr. Forrest, also took some lunar photographs in 1854, by means of an 8-inch refractor, and exhibited the results at the above meeting (*ibid.*, p. 66).

Prof. Crookes began work with the same instrument in 1854, and his first step towards obtaining good negatives was the introduction of the purest chemicals. This, and a strict adherence to correct formulæ, enabled him to reduce the exposure from thirty to four seconds. The diameter of the moon's image in the first focus of the instrument used was 1·35 inch, and the negatives obtained bore an enlargement of twenty times, but on account of the proportional magnification of defects in the film, the results were not perfect. To eliminate defects arising from this cause, Prof. Crookes suggested that "The magnifying must be conducted simultaneously with the photographing, either by having the eyepiece on the telescope, or, better still, by having a proper arrangement of lenses to throw a magnified moon image at once on the collodion" (Roy. Soc. Proc., vol. viii. p. 363, 1857).

In 1857, Mr. S. Fry obtained photographs of the full moon by means of an eight and a half inch refractor. With this instrument it was found that the average exposure for the full moon was three seconds, for half moon twelve seconds, and for quarter moon forty-five seconds; collodion plates being used. Mr. Fry observed that the distance of the chemical focus from the object-glass was subject to variation, the change being most probably due to variations in temperature (*Photographic Journal*, vii. p. 80, 1862).

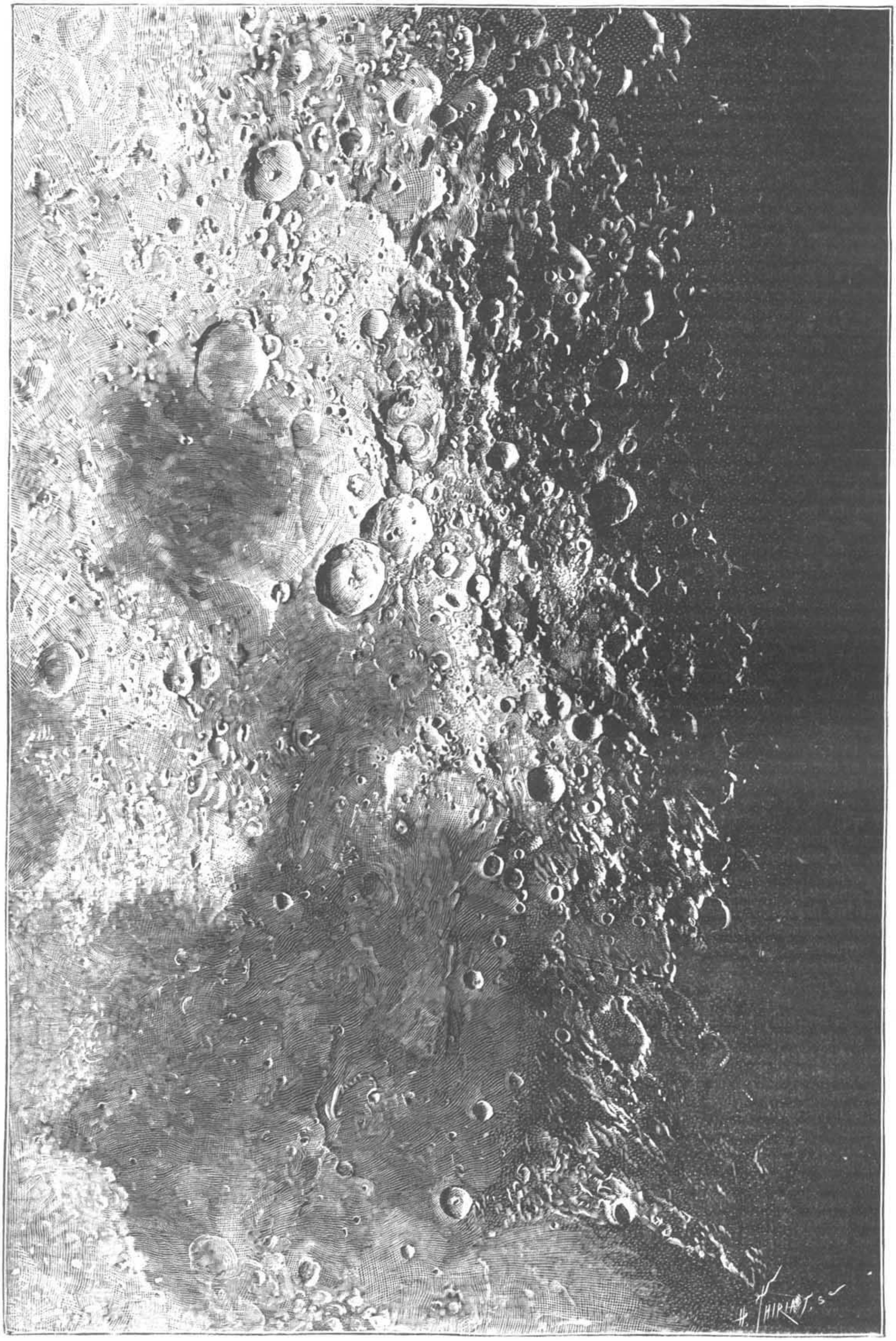
Secchi paid much attention to the photography of particular portions of our satellite, and during the first quarter. The chemical activity of the light of the moon at full and at first quarter was found to be in the proportion of three to one (*Comptes rendus*, vols. xlii., xlvi., 1856, 1858). In 1857, Sir Howard Grubb, using a refractor of 12 inches aperture, obtained photographic images of the moon a little over two inches in diameter with exposures from ten to forty seconds. A sliding back similar to that invented by De La Rue and afterwards improved upon by Lord Rosse, was used to follow the moon's motion. The improvement consisted in the application of clock-work motion to the slide in order to follow motion in declination and in regulating the driving clock of the equatorial to follow the moon in right ascension (Dublin Photographic Society, May 6, 1857.)

Although De La Rue obtained some excellent photographs in 1852, when working under very disadvantageous conditions, it was not until 1857 that he began to produce those detailed representations of the lunar surface that have made his name immortal. The want of a driving clock was the cause of the cessation of lunar photography in the former year, and when this had been supplied, De La Rue continued his work. Numerous positives on glass and negatives slightly more than an inch in diameter were obtained. These were perfectly defined and bore a magnification of more than 16 diameters. In 1859, at the British Association meeting held at Aberdeen, De La Rue reported "On the Present State of Celestial Photography in England," and exhibited some of the fruits of his labour. Amongst the specimens were positive enlarged copies of other negatives, eight inches in diameter, which would bear still further enlargement, and instantaneous pictures of the full moon. It was noted that very strong pictures of the full moon were produced with exposures from one to five seconds, and that the crescent moon required from twenty to thirty seconds. A great part of the report was devoted to a discussion of the methods adopted in taking stereoscopic pictures of the moon, many photographs of this character being exhibited at the meeting.

The extensive multiplication of enlarged copies of De La Rue's negatives renders it unnecessary to expatiate on their excellency. A magnificent series of twelve photos was published in book form, and also enlarged so that the lunar disk had a diameter of seventeen inches. In this series the moon's progress was traced from the time when she was six days old through the waxing and waning periods to the 23½ day. Each of the pictures was a work of art, whilst the many details they contained gave them a high scientific value, and conclusively demonstrated the applicability of photography to the delineation of celestial bodies.

An enlargement three feet in diameter, from a negative taken by De La Rue in 1858 is suspended in the library of the Royal Astronomical Society.

Rutherford began his work in lunar photography in 1858 with a refractor having a focal length of fourteen feet, and an aperture of eleven and a quarter inches. By reducing the aperture of the telescope to five inches for the full moon, negatives were produced which would bear enlargement to fifty diameters, or five inches. In the same year, whilst De La Rue was obtaining stereoscopic pictures in England, Rutherford was working in the same direction in America, and with similar results. To the general public the photographs taken by Rutherford in 1858 left little to be desired, but they did not reach that degree of perfection which is necessary to satisfy a scientifically cultured mind. A mirror having a diameter of thirteen inches was therefore worked and fixed on the tube of the refractor in 1861. The results obtained were, however, still deemed unsatisfactory. The mirror soon became tarnished by the action of the combustion products of the gas used for illuminating purposes, while the motion of vehicles in the



Central Region of the Moon. (From a Photograph by the Brothers Henry.)

neighbouring street gave it vibrations, which by reflection were doubled in amount. The reflector was therefore abandoned, and Rutherford resolved to have an object-glass made of the same size as that formerly used by him, but specially corrected for photographic rays. With the completion of this instrument Rutherford's best results began. In March 1866, some remarkably fine negatives were obtained with exposures from two to three seconds three days after the first quarter, and one-quarter of a second for the full moon. The publication of enlargements from these negatives, having a diameter of twenty-one inches, was much appreciated by astronomers and others interested in lunar photography.

No man has done more in the furtherance of celestial photography than Dr. Henry Draper, the son of the renowned physicist to whom reference has already been made. After a brilliant scholastic career he was associated with his father in many important researches. A journey to the British Isles in 1857 gave Dr. Draper the opportunity of visiting Lord Rosse's observatory at Parsonstown. He was so struck with the power of the great reflecting telescope, that on returning to America in 1858 he began the working of a similar speculum having a diameter of 15 inches. This was afterwards discarded, and a silvered glass Newtonian reflector, having a diameter of 15½ inches, was constructed, and adapted for celestial photography. Detailed descriptions of the construction and testing of the mirror, the method of silvering, and the manner in which it is mounted, are embodied in a memoir by Dr. Draper "On the construction and use of a silvered glass telescope, 15½ inches in aperture, and its use in celestial photography" ("Smithsonian Contributions to Knowledge," vol. xiv. p. 52, 1864). Instead of driving the telescope in the usual way by means of a clock, Dr. Draper used a sliding plate holder, driven by a "clepsydra" specially devised for the purpose. Some perfectly defined negatives were obtained in 1863, about 1½ inches in diameter; many of them were enlarged to 2 feet, and from one a magnificent picture was made in which the lunar disc had a diameter of 50 inches. The beauty of the copies was probably due to some extent to the fact that a concave mirror was used instead of a combination of lenses in the process of enlarging.

From the time when Dr. Henry Draper produced his best results until last year very little remarkable work had been done in lunar photography. In 1866, Mr. A. Brothers took several good negatives $\frac{11}{16}$ of an inch in diameter in the first focus of a 5-inch refractor, and by the insertion of a Barlow lens he increased the size of the image to 1¼ inches. Enlargements from these negatives were distributed to many astronomers, and evidence of their excellency is afforded by the circumstance that they were mistaken for some of Rutherford's productions by the editor of a scientific journal, and commented upon as such. Mr. Brothers gave a long account of the development of celestial photography in the paper in which his method of work was described (Proceedings of the Literary and Philosophical Society of Manchester, vol. v. p. 68, 1865-66.)

In 1872, Mr. Ellery, the Director of Melbourne Observatory, presented some remarkably sharp lunar photographs to the Royal Astronomical Society, that he had obtained by means of the great reflector (*Monthly Notices R.A.S.*, vol. xxxiii. p. 219, 1873.)

Amongst other lunar photographs possessed by the Royal Astronomical Society are two taken by Dr. Gould at Cordoba Observatory in 1875-76, in each of which the moon has a diameter of nearly 20 inches. A photograph taken in 1877 by Prof. Pritchard at Oxford, with the reflector used by De La Rue, and some taken in 1880 by Mr. Common with his three-foot reflector, also figure in the above collection as remarkable works of art having an important scientific signification.

In a recently published paper on "Astronomical Photography at the Lick Observatory" ("Publications of the Astronomical Society of the Pacific," vol. ii., No. 9), Prof. Holden gives a detailed account of the photographic apparatus of the great equatorial, and the work done with it. The image of the moon in the first focus of this instrument is nearly five and a quarter inches in diameter, and the negatives bear easily an enlargement of 570 diameters, and even double this amount. In the production of these negatives the aperture of the object-glass was reduced to 12 inches. From an examination of the best pictures yet taken at the Lick Observatory, Prof. Holden finds that parallel walls on the moon whose tops are no more than 200 yards or so in width, and which are not more than 1000 or 1200 yards apart, are plainly visible. A series of copies from the negatives obtained at Lick Observatory has been published.

Some photographs of the moon taken in March last, by the Brothers Henry, at Paris Observatory, appear to eclipse all previous ones. The instrument used was the 13-inch photographic equatorial, and an examination of the plate which accompanies this note will show that real progress has been made. The superiority of the results is due not only to the perfection of the object-glass, but to the use of a secondary magnifier, by means of which the size of the image at the first focus was increased fifteen times. It is manifest that this method of direct enlargement possesses many advantages over that ordinarily used, and its further development will be awaited with considerable interest.

There is no doubt that enlarged photographs of our satellite are capable of affording more information regarding its surface than can be gained by years of diligent observation, whilst their multiplication at different epochs will enable selenographers to readily detect changes of a comparatively minute character. The study of the lunar surface has always excited interest. Hence the contribution to knowledge afforded by the photographs taken by MM. Paul and Prosper Henry will not lack the appreciation it fully deserves.

RICHARD A. GREGORY.

COMPARATIVE PALATABILITY OF INSECTS, &c.

IN the course of last autumn and the present summer we made a series of experiments bearing upon the relative palatability of insects, &c.,; the animals chiefly experimented on being domestic mice, common toads, and a common Mynah (*Acridotheres tristis*). We obtained the following results.

Among beetles, *Carabus violaceus*, which emits a very strong, unpleasant-smelling fluid, was once eaten by the toads, and twice by the mice. As a rule, however, it seemed too large and strong for either. The Mynah, also, was not very fond of it.

Torostichus niger, and the nearly-allied red-legged species, which also emit strong-smelling fluid, were readily taken by all the animals under observation: though they sometimes caused the mice a little trouble.

The small copper-coloured ground-beetles were eaten readily by the Mynah and toads, but in every case refused by the mice.

Melolontha vulgaris was liked by the mice and toads. We did not offer it to the Mynah.

Coccinella bipunctata was invariably licked and refused by the mice, even when hungry. The toads took it readily. We did not offer it to the Mynah.

Ocypus olens, the "devil's coach horse," was taken without hesitation by the toads, even in its defiant attitude, with the head and abdomen erected. On one or two occasions, however, it was immediately ejected. This has also happened with *Torostichus niger*, and appears